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# (54) Temperature sensing assembly for an electrical radiant heater

(57) A temperature sensing assembly for use with an electrical radiant heater disposed below and in spaced relationship to a cooking plate 14 comprises a thermally conducting composite coupling plate 18 having two layers 18*a* and 18*b* of substantially equal thickness, one layer 18*a* being of good thermally conducting non-ferrous metal, e.g. aluminium, and the other layer 18*b* being of iron or steel. The coupling plate 18 bears against the cooking plate 14, extends over the heating element of the radiant heater in spaced relationship thereto, and also extends externally of the heating zone where a temperature sensor is disposed in heat transfer relationship with the coupling plate 18. The layer 18*a* bears against the cooking plate 14 which is preferably a glass ceramic cooking plate and the opposite face of the coupling plate 18 is preferably coated with a thin aluminium plating 18*c*.

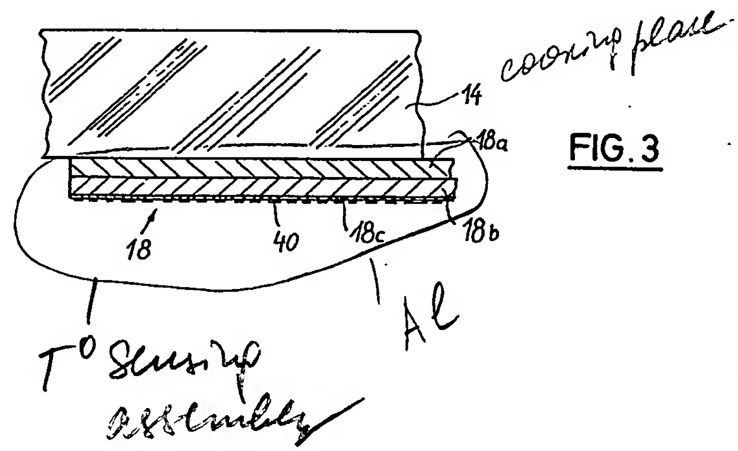


FIG. 3

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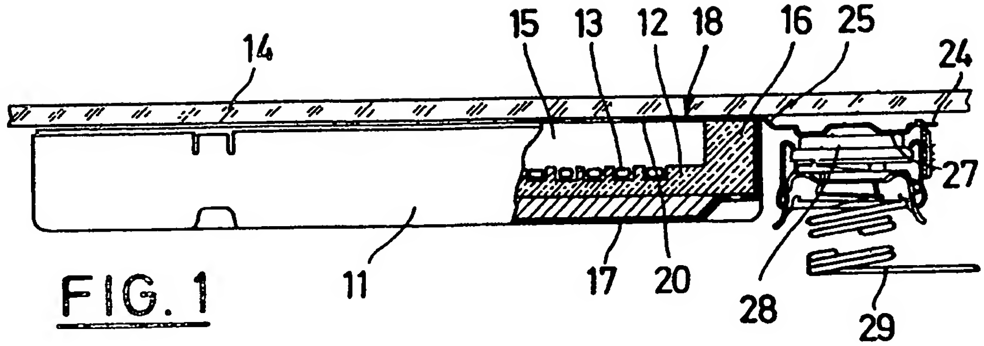
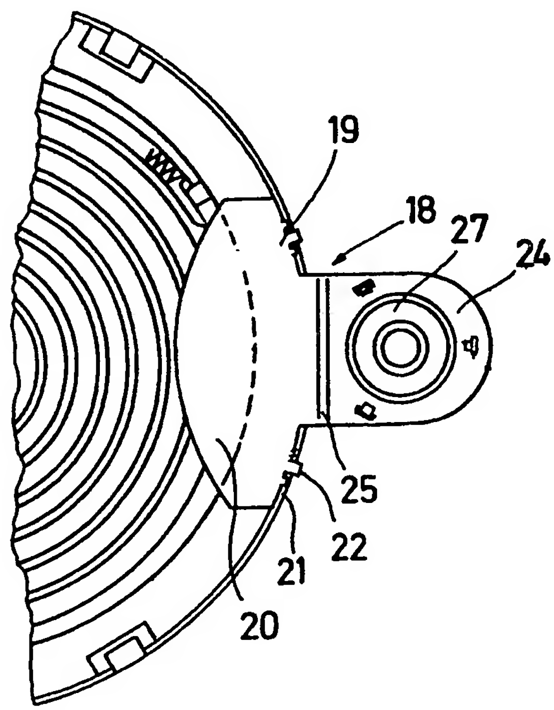



FIG. 1

FIG. 2



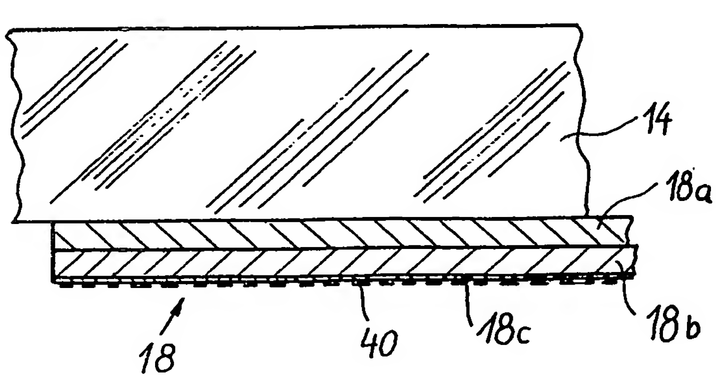




FIG. 3

SPECIFICATION

**Temperature sensing assembly for electrical radiant heaters**

This invention relates to a temperature sensing assembly for a cooking plate heated by an electric radiant heating element disposed below the plate, the assembly including a coupling plate which bears against the cooking plate and a temperature sensor arranged in heat transfer relationship with the coupling plate outside the heating zone.

Coupling plates have been disclosed in US PS 3 612 829 and 3 624 352, which are disposed, in the case of a radiant heater, between the edge of the insulator carrying the heating resistors and a glass ceramic cooking plate, and thus sense the temperature of the glass ceramic plate in an edge or peripheral zone. A direct thermal influence of the radiant heater is, however, scarcely possible here, so that the sensor connected with the coupling plate, particularly on account of the low thermal transverse conductance of the glass ceramic plate, cannot provide adequate protection against overheating.

In DE-OS 27 47 652 a coupling plate has been disclosed which is laid between a medium sensor filled with an expansion liquid and a glass ceramic cooking plate.

In this case, a contact heater is involved, the internal winding of which bears against the edge of the coupling plate. A coupling is provided between the temperature sensor and the temperature of the cooking vessel and the heater, but this device is not intended for radiant heaters. The coupling plates disclosed are of good thermally conducting metals, such as aluminium.

In DE-OS 29 23 884 and our EP-OS 00 21 107, it has been proposed to construct a coupling plate so that it covers a portion of the edge or peripheral zone of the heating element and bears, in this region, also against the underside of a glass ceramic cooking plate. This coupling plate can, according to our EP-OS 00 21 107, be of an aluminium plated steel sheet the surface of which, in the heated region, can be coated with a matt black, heat-resistant lacquer, acting as black in regard to radiant heat.

It is an object of the present invention to provide an improved temperatures sensing assembly for use with radiant heaters whereby an improved coupling of the temperature sensor both to the temperature of the cooking plate and also to the heater shall be obtained.

According to the present invention there is provided a temperature sensing assembly for use with an electrical radiant heater disposed below and in spaced relationship to a cooking plat , the assembly comprising a coupling plate in the form of a composite sheet having a layer of good thermally conducting non-ferrous m tal and a layer of iron or st l, the layers being of substantially qual thickn ss and being bonded or connected together, th coupling plate being adapted to bear against th cooking plat and to extend both over th radiant heater in spaced relationship and externally of the heating zon and a t mperature sensor outside the heating zone and in heat transfer relationship with the coupling plate.

The invention extends to an assembly comprising a cooking plate with radiant heaters disposed below the cooking plate in spaced relation thereto and incorporating a temperature sensing assembly according to the immediately preceding paragraph.

The invention further extends to an assembly comprising a cooking plate, a radiant heater device for the cooking plate disposed below the cooking plate and defining a heating zone and incorporating a radiant heater element in spaced relationship to the cooking plate, a coupling plate extending into the heating zone in contact with the cooking plate and spaced from the heating element and externally of the heating zone and a temperature sensor disposed outside the heating zone and in heat transfer relationship with the coupling plate, the coupling plate being formed from a layer of non-ferrous metal and a layer of iron or steel, the layers being of substantially equal thickness and being united to form a composite plate.

The non-ferrous metal layer of the coupling plate desirably faces towards and bears against the cooking plate. The non-ferrous metal is preferably aluminium, advantageously a relatively soft pure aluminium, which with a good temperature conductivity can be readily applied by rolling on to iron or steel sheets.

Due to the fact that the coupling plate partly extends over the heating zone of the radiant heating element, preferably at an edge or peripheral region, the direct heating influence of the heating element can be picked up. However, the temperatures at the coupling plate are extraordinarily high, so that it must be made from a very heat-resistant material, in order on the one hand not to flake and on the other hand to retain its shape and configuration. In our earlier filed EPO application, No. EP 0021107 A, we have proposed a coupling plate made from aluminium-plated steel sheet, which means that on to both sides of the steel sheet a very thick aluminium layer having thicknesses between a few hundredths to one tenth of a millimetre (preferably 0.05 mm) is rolled. This thin layer prevents scaling or flaking of the iron sheet, and due to an intermetallic bonding between aluminium and iron in this thin boundary zone, when heating up occurs, a very resistant and stable layer with a black-grey colour is created which has good absorption properties for the radiant h at.

Th use of materials other than iron or ste l, for example of non-ferr us metals such as brass, copp r or aluminium, has not led to succ ss on account f th deficient temperature and flaking resistance.

Because f the v ry high temperatures of th radiant heater el ment, it has hitherto been

nec ssary for the thermal path between th temperature sensor and the heating resistor to be made very long, i.e., th coupling plate has had to be design d with a relatively low conductance. Only in this way was it possible to achiev the result that adequately large quantities of food could be heated up in a short time without the regulator in the meantime switching off the heater. The effect of a cooking vessel on a coupling plate or regulator situated below the cooking plate was relatively small. It was therefore very difficult for the temperature sensor to identify whether a filled pot was standing on the cooking plate or, for example, in the case of frying, a virtually empty pan. Added to this is the fact that, for frying temperatures, high regulator settings are necessary and this in turn has the consequence that the first heating up then takes a comparatively long time and, in certain circumstances, can lead to a too high initial temperature of the empty pan. Even in warming-up procedures it has been observed, on account of the slow temperature transfer, that the switching-off of the regulator took place too late so that, in the case of sensitive dishes, they could burn on to the cooking pot.

These disadvantages have been overcome by the invention. Although it might well be assumed that inside a composite coupling plate a temperature jump hardly occurs, the penetration effect of the cooking plate component upon the temperature sensor and controller is considerably greater than hitherto and the aforementioned disadvantages can be eliminated.

It is possible to use materials which themselves cannot be subjected to the radiation temperatures without undergoing changes such as, for example, aluminium which could melt or at least considerably deform at the high temperatures to which it is exposed. By the steel plate bonded to it, the aluminium is held in the desired form, shape and configuration and, furthermore, as it is preferably disposed on the side facing towards the cooking plate, it is cooled by this plate and shielded by the iron or steel layer. The preferred thin aluminium plating of the iron or steel layer provided on the opposite side does not behave as aluminium, on account of the intermetallic bonding with the iron or steel, and can therefore be subjected to the full heat radiation.

If a relatively soft non-ferrous metal layer, such as pure aluminium, is used, then with an appropriate dimensioning (approximately equal thicknesses) no substantial bimetallic effect occurs, which effect could result in the coupling plate, which preferably cantilevers freely from the edge of the heating zone into the region of radiant heating, sinking down towards the radiant heating lement when it is h ated. Thus a good bearing contact of the coupling plate on the cooking plate is achieved ov r the ntire t mp rature rang . It could, howev r, b desir d, in order to adapt to the control prop rties in certain circumstanc s, for the c upling plate to be displaced away from th cooking plate in the higher temp rature range, in order then to b less cooled by the co king plate and to lead to a more rapid switching off. In this case, th choice of mat rial could be such that th coupling plat behav s like a bimetallic plate.

One embodiment of the invention will now be described by way of example, reference being made to the accompanying drawings in which:—

Fig. 1 is a longitudinal section through a temperature sensing assembly according to the present invention,

Fig. 2 is a plan view of the radiant heating element (without cooking plate), and

Fig. 3 is an enlarged detailed section of a fragment of Fig. 1.

Fig. 1 shows a radiant heater device 11 comprising an upwardly open sheet metal shell 17 in which a similar shell-shaped heat insulating lining 12 is disposed, in which lining an electrical radiant heating element 13 is disposed which is in the form of coils with a flattened oval basic form and which lies in a spiral groove. The heater device 11 is resiliently urged from below against a glass ceramic cooking plate 14 and provides the heater for a cooking unit. Each heater device 11 heats one cooking position and, on account of the spacing between the radiant heating element 13 and the glass ceramic cooking plate 14, does this predominantly by radiation.

The heat insulating lining 12 has an upstanding peripheral rim 16, the upper face of which projects above the upper edge of the sheet metal shell 17 and is intended generally to bear against the lower face of the glass ceramic cooking plate 14. A coupling plate 18 has a part 19 which extends between the rim 16 and the cooking plate 14 and has the form of a substantially flat plate, preferably provided with beadings, not shown, to stabilise it.

As can be seen from Fig. 3, the plate 18 and particularly the part 19 is of a composite material which has two layers 18*a* and 18*b* united, bonded or otherwise connected together, e.g., by rolling. The layer 18*a* faces towards and bears against the cooking plate 14 and is of aluminium, preferably a relatively pure aluminium, and the adjacent layer 18*b* is of normal iron or steel sheet. On its lower face the coupling plate 18 is provided with a coating 18*c* in the form of an aluminium plating which is furnished with a coating 40 of a lacquer which is dark or black and heat absorbent. The thicknesses of the layers 18*a* and 18*b* are substantially equal and each of the order of one half of a millimetre, preferably between 0.3 and 0.6 mm, while the plated layer 18*c* is less than one-tenth of a millimetre (preferably 0.05 mm) thick. The very thin lacquer coating 40 does not need to be xcessively heat-resistant, because aft r th first few uses it is replac d by a similar radiation-absorbing layer which results from an intermetallic b nding between the aluminium plating 18*c* and th iron or steel layer 18*b*. Thus the coating 40 is of importance only for the first few uses of the cooking plate.

The form of th coupling plate, as can b s n in Fig. 2, is substantially T-shap d in plan. The T-beam provides th el ngated part 19, which bears in the circumferential direction of the substantially circular heater device 11 against the edge or periphery thereof. This part 19 is approximately lens-shaped and possesses a likewise lens-shaped region 20, which projects inwardly from the rim 16 to the heated zone 15 of the radiant heater device 11 and partly extends over in the edge or peripheral area of the heating element 13. The remaining part of the part 19 lies between the rim 16 and the cooking plate 14.

At the edge 21 of the region 19, resilient fixing lugs 22 extend outwardly of the heating zone to provide a means whereby the coupling plate 18 is firmly clamped to the edge of the sheet metal shell 17. By this push-on fixing and the firm fixing between the rim 16 and the cooking plate 14, the coupling plate is firmly held in close contact with the cooking plate 14.

An external portion 24 of the coupling plate 18 projects outwards away from the heating zone beyond the rim 16 of the heater device 11. It is offset downwards somewhat by a bend 25 so as not to bear against the underside of the cooking plate 14 at this point. A downwardly facing annular heat transfer surface 27 is formed on this outwardly extending portion 24 and a temperature sensor box 28, filled with expansion liquid, is pressed against this transfer surface 27 from below in heat transfer relationship thereto. This box is connected by a capillary tube 29 with a temperature regulator, not illustrated here, for controlling the heating of the heater device 11. An alternative temperature sensor, for example an electrical one, could however be used. Likewise, the form of the external portion 24 and the position of the temperature sensor are not of substantial importance in regard to its function.

## Claims

1. A temperature sensing assembly for use with an electrical radiant heater disposed below and in spaced relationship to a cooking plate, the assembly comprising a coupling plate in the form of a composite sheet having a layer of good thermally conducting non-ferrous metal and a layer of iron or steel, the layers being of substantially equal thickness and being bonded or connected together, the coupling plate being adapted to bear against the cooking plate and to extend both over the radiant heater in spaced relationship and externally of the heating zone and a temperature sensor outside the heating zone and in heat transfer relationship with the coupling plat .

2. An assembly according to claim 1 in which the non-ferrous metal layer is adapted to fac towards the cooking plate.

3. An assembly according to claim 1 or 2 in which the face of the iron or steel layer remote from th lay r of non-ferrous metal is provided with a coating of aluminium plating.

4. An ass mbly according to claim 3 in which the coating has a thickness less than 0.1 mm.

5. An assembly according to any one of the preceding claims in which the non-ferrous metal is aluminium.

6. An assembly according to claim 5 in which the non-ferrous metal is soft pure aluminium.

7. An assembly according to any one of the preceding claims in which the thickness of the layers lies in the range of from 0.3 to 0.6 mm.

8. An assembly according to claim 7 in which the thickness of the layers is 0.5 mm.

9. An assembly according to any one of the preceding claims in which the layers are bonded or connected together by plating or rolling.

10. A temperature sensing assembly constructed, aarranged and adapted to operate substantially as herein described with reference to the accompanying drawings.

11. An assembly comprising a cooking plate with radiant heaters disposed below the cooking plate in spaced relationship thereto and incorporating a temperature sensing assembly according to any one of the preceding claims.

12. An assembly comprising a cooking plate, a radiant heater device for the cooking plate disposed below the cooking plate and defining a heating zone and incorporating a radiant heater element in spaced relationship to the cooking plate, a coupling plate extending into the heating zone in contact with the cooking plate and spaced from the heating element and externally of the heating zone and a temperature sensor disposed outside the heating zone and in heat transfer relationship with the coupling plate, the coupling plate being formed from a layer of non-ferrous metal and a layer of iron or steel, the layers being of substantially equal thickness and being united to form a composite plate.

13. An assembly according to claim 12 in which the layer of non-ferrous metal contacts the cooking plate.

14. An assembly according to claim 12 or 13 in which the face of the iron or steel layer remote from the cooking plate is provided with a coating of aluminium plating.

15. An assembly according to claim 14 in which the coating has a thickness of 0.1 mm.

16. An assembly according to any one of claims 12 to 15 in which the non-ferrous metal is aluminium.

17. An assembly according to any one of claims 12 to 16 in which the thickness of the layers lies in the range of from 0.3 to 0.6 mm.

18. An assembly according to claim 17 in which the thickn ss of th layers is 0.5 mm.

19. An assembly according to any one of claims 11 to 18 in which the cooking plat is a glass ceramic cooking plat .

20. An assembly acc rding to claim 12 constructed arranged and adapted to operate substantially as h rein described with r ference to the accompanying drawings.

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